ONSITE WATER TREATMENT
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How Do You Solve a Problem Like Uranium?

Photo: Water Remediation Technology

Uranium and radium naturally occur in untreated drinking water and wastewater.

Onsite treatment for radioactive elements in drinking water

By Peter Hildebrandt

At Bass Lake, CA, surface water is the primary source for drinking water. In peak summer months that changes as vacationers inundate this highly recreated area, increasing Bass Lake's population and forcing the area to use well water to supplement its supply. According to Ron Dollar, vice president for sales and marketing with Water Remediation Technology LLC (WRT), in Wheat Ridge, CO, it's at this point that radiation becomes an issue: The deeper the wells are sunk, the greater the tendency to have a problem with radium or uranium.

WRT has installed its uranium removal system at the well at Bass Lake. Media in the lead vessel of the system do most of the work. The lag vessel is mainly for polishing and safety; therefore, when media are exhausted in the lead vessel WRT replaces the media. The media for the second vessel are moved into the first vessel and the new media are placed in the lag vessel. With this strategy, the standard interval between media replacements in each vessel is one to two years.

"They've used this in other states and it seemed like a good technology," says Carl Carlucci, a California Department of Health and Safety senior engineer. Carlucci's agency regulates water companies in the state. "The problem with uranium removal has always been not so much the removal process, but its disposal. WRT actually has a materials license to haul and dispose of it out of state. Regular landfills aren't an option.

"There are other systems in the Bass Lake area which have problems. We're hoping the WRT system works out so we can install similar systems in that same area. WRT has done a short pilot in which 10 bed volumes were run. This is simply running 10 times the amount of water through the media followed by a sampling just to prove it worked. This worked fine for us."

Do It Now or Later

States are now monitoring for radioactive substances in their sludge and effluent water slated to be released back into the environment. By taking these substances out of the drinking water

first, they can minimize any amounts they must deal with at the wastewater end of things, not to mention the health benefits to water users. “We in effect take it out of both the water and the local environment once and for all,” says Dollar.

As our technology grows, so does our ability to test for all sorts of substances in our water supplies. One source of unease is the presence of radioactive substances in water, particularly uranium and radium, two elements naturally occurring in the earth and of concern when it comes to groundwater supplies. Areas of the US where natural radioactivity in geologic formations is prevalent include the West, chiefly in Colorado and California; the Midwest, such as in Wisconsin; the Mid-Atlantic states in a long band along the coast; and a large section of the piedmont through North and South Carolina.

Population density also comes into play with the issue. In larger metropolitan areas, where there is a reliance on surface water, the issue of uranium or radium in water is less prominent than in smaller communities, with some wholly dependent on groundwater for their needs.

Radionuclide Rule and Repercussions

Recently a mandate called the Radionuclide Rule was passed requiring water systems in the US to monitor for radionuclides. Under the rule, gross alpha emitters, gross beta emitters, radium 226, radium 228, and uranium must be monitored. Monitoring for the most part began in 2005. Prior to the new rule, water systems monitored radionuclides in the distribution system at the customer’s tap. The existing rule did not take into account all the different entry points that could be pumping water into that system.

With the change in the rule, each individual entry point or well was to be monitored. When it was discovered which particular locations had issues with uranium and radium, that’s when treatment began to be applied. US Nuclear Regulatory Commission (NRC)issues cropped up after a number of systems were found to have uranium contained within them. They were treated for uranium and due to the buildup of those concentrations, jurisdiction now falls under the NRC regulations.

Many utilities and private water providers across the US (such as Aqua America Inc., the largest US-based publicly traded water company) are now paying attention to radium, even though the NRC is not dealing with radium in this application at this time.

History of the Ruling—An Unfunded Mandate

The NRC originally regulated uranium and thorium as part of the US energy program. Then the states took control over that, adopting the NRC regulations, making them at least as stringent as the federal regulations. The NRC still regulates source material in 16 non-agreement states. The rest of the states, agreement states, entered into an agreement with the NRC to regulate that material.

The NRC issued a license to WRT enabling it to operate any of the uranium removal systems it would install for a city in any of the 16 non-agreement states. “That really is a first-of-its-kind license the NRC has issued,” says Duane Bollig, vice president of environmental and government

Photo: Bass Lake Water Co.

Communities with a heavy reliance on groundwater have a greater risk.

affairs with WRT. “It was an innovative process which both we and the NRC went through. It is a multisite license so this will save us much time in going through a separate licensing process for each one of those. Likewise, the NRC also did not have the manpower or staff to go through a separate application.”

The license WRT obtained involved a 16-month process. “One thing we’ve heard from all the regulators, whether it was the NRC or the states, is this whole radionuclide water treatment requirement. The year 2000 Radionuclide Rule, which is an addition to the Safe Drinking Water Act, really was an unfunded mandate dropped in the middle of the city water systems’ lap, but the EPA dropped it in the regulator’s lap as well,” says Bollig.

“Radiation protection regulators simply don’t have the staff or the time to individually license each one of these facilities. Though the rule was adopted in 2000, it didn’t go into effect until 2003 because the EPA wanted to give the states and the drinking water regulators an opportunity to set up a program to regulate this.

“The compliance monitoring period is from December 2003 until December 2007, when water companies and systems are required to monitor and see if they are out of compliance. That monitoring requires that they take at least four quarters’ worth of samples as well.”

By January 1, 2008, all systems are supposed to be in compliance, due to the end of this monitoring period. The NRC issued the multisite license after WRT had submitted technical information on the range of systems it would expect to see. The NRC also did an analysis on that full range of systems and issued the license. Now when WRT enters into a new treatment contract with a water company, all WRT has to do is document to the NRC that this new system or set of wells is within the range that it’s already analyzed.

“Basically what we do is register that city or water system with the NRC under our license,” says Bollig. “From the way they’ve explained it they’ve issued multisite licenses to other government agencies, such as the Navy for some type of operation or facilities. But as I understand it, this is the first time they’ve issued a multisite license in this format to a private company. It truly is a groundbreaking process. This has actually streamlined the process. But in the end, whether we are dealing with radium or uranium, we’re still dealing with relatively low-level, naturally occurring radioactive materials.”

When it comes to interpretation of radiation levels, especially those offered by the EPA, Bollig is somewhat skeptical. “We live in a sea of radiation,” says Bollig. “How do you break out effects of drinking radium in your drinking water versus effects from smoking on individuals who smoke?” asks Bollig. “We have plenty of direct links with high exposures and deaths or illness with radiation, from such places as Chernobyl or Hiroshima; but I’m not sure it drops as a straight-line curve as the EPA suggests when it comes to these things in the amounts they are found in drinking water.

"Also, the uranium limit of 30 milligrams per liter was not really set because of the radioactivity of uranium. That level was set more because of the heavy metal chemical toxicity of uranium. Yes, it is radioactive material, but it is a very low radioactive type material."

Seeing That It Goes No Further

"We are being very successful in getting systems in," says Bollig. "Part of the reason for this is that many of the water systems agree with our philosophy that once the radioactive material is removed from the environment, it makes no sense to place that material back into the environment."

Photo: Water Remediation Technology

Treatment systems must follow radiation guidlines by 2008.

The idea of developing a treatment medium in which the water is passed through the medium and the radium or uranium attaches itself to the medium was actually developed by WRT, according to Dollar. Other companies have developed systems that work in a similar manner, often called ion exchange.

"Ion exchange can also be used to take those things out, but what we call this is an absorptive media process," says Dollar. "This is very similar in terms of how the mechanics of the media works. How they differ is when it comes to the ion exchange process. Those typically use a backwash step to clean the media after a certain amount of time has gone by. Saltwater or brine solution makes the media give up the contaminant, which is then sent to the wastewater plant."

Photo: Water Remediation Technology

Radiation removal technology has the potential to develop into a similar process for other water contaminants.

The next thing that happens once the contaminants are taken out of the water is figuring out what to do with them. In the case of many things removed from water such as solids, irons, and other contaminants, they are not hazardous and can simply go to the wastewater treatment plant or the normal landfill. But in the case of radium and uranium, there is a treatment residual that is hazardous and requires special handling and care.

Dollar came from the municipal water industry with about 20 years of experience in that area. "At the same time, during the years of our startup, we looked at new water regulations made public by the EPA. The EPA regularly adds additional water-quality criteria through the Safe Drinking Water Act, which has to be met by water providers."

One of the things occurring around this same time was the Radiological Contaminant Rule (RAD Rule). It contained a new requirement to meet a minimum level or maximum contaminant level (MCL), including both maximum allowable radium level and maximum allowable uranium level in drinking water. These meant communities were now going to be testing their water to

see if those two levels in the water were over the limit, and if they were, treatment would have to be installed so that the proper levels were met.

Those issues converged for WRT, which figured out it could use a treatment process using its media, formulated to remove radium or uranium from drinking water. “This is where all this began for us,” says Dollar. “We then developed a process in which we could take those things out of the water.”

WRT studied the municipal water industry and started looking at a natural mined substance called zeolite. Zeolites often find use as substrates because they have very high surface areas. With lots of fissures and openings in it, the surface areas extend even to the microscopic level. This is formulated to make it as specific as possible for the removal of uranium or radium or whatever it’s being targeted for. Their source for the material is a mine site in central Wyoming. The company has found zeolite of just the right quality for what it is accomplishing.

Perhaps the thing that is most unique about the WRT system is that it’s a zero liquid discharge system. No water is wasted. All the water coming into the system is treated and usable. “Other systems run,” says Dollar. “Then they stop, they clean the media, and water is used to do that. But some portion of the water ends up with all the ‘bad’ stuff in it.

“We treat all the water coming in and then bad stuff winds up in our treatment media, which is taken to a site where it’s used. This is a real big deal in many areas of the country such as the Southwest. In those areas they cannot afford to throw away even a portion of their water; they need every drop and more.”

The WRT is one of the first companies to develop an arsenic removal medium. “But the reality is that arsenic got such a media play at first,” says Dollar. “It is also fairly easy to remove from water; once a lot of companies started figuring that out, many got involved. The residual is also fairly easy to dispose of because it has no unique properties and can be fairly easily prepared for disposal in a normal landfill.”

Disposing and Reusing

RMD Operations LLC was formed by WRT to handle all the permits, radioactive materials licensing, and all the radioactive materials, while WRT develops the technology and marketing. The companies remain under the same ownership. Though their present focus is on treating for uranium and radium, they are looking to develop systems for other contaminants such as arsenic, barium, and many other substances.

WRT was quick to realize, as a business model, that supplying equipment to remove uranium and radium was only part of the problem. It studied the problem with an eye to an environmentally sound solution from the beginning. In the case of uranium, there are waste facilities where byproducts can be stored, but it’s still a disposal site where perpetual care is provided. For uranium, WRT looked one step further and pursued a use beyond disposing of the substance.

“We went out and made an agreement with a uranium processor,” says Dollar. “The uranium removed from the water and on our treatment media in a solid form is taken to the processor. Uranium is stripped off and used in their fuel cycle along with the uranium they’ve mined out of the ground. Therefore we’re now recycling a waste product and not disposing of it.

“From a utility standpoint, the long-term liability in the ownership of that contaminant resides with anybody who has handled it along the way—and stays with them forever. When we are able to take the uranium to a processor and enter it into the fuel cycle, the chain of liability

comes to an end for them."

In the case of radium, there is no longer a use for this contaminant, but WRT negotiated long-term disposal agreements with various sites in order to be able to offer customers long-term pricing, handling, and disposing of this contaminant. A total solution is still provided; it's just that now the end result with radium is not quite as elegant is it is in the uranium business, according to Dollar.

WRT's primary customers are municipalities and communities operating their own drinking water division, those with their own surface water or groundwater treatment plants. Radium and uranium are both naturally occurring elements and show up mainly in water from groundwater sources.

First User of a Radium Removal Process

Jerry Weaver, director of public works in the Village of Oswego, IL, is pleased with how its WRT system has worked out. The village's system was installed in April 2005. Oswego now has seven wells online all with the WRT system. Village managers thought they would have had to do a change-out of the zeolite media earlier but now anticipate such a replacement in fall 2007, or early in 2008.

"Through this whole process we haven't had to add extra staff or spend any extra time at the wells," says Weaver. "It's a very hands-free system. Pressure valves are present in many locations to make sure it's running OK. One of the biggest selling points for our city was that it is the most economical system out there; when they say it removes the radium, it really does in fact accomplish that. It's not simply backwashed into some sand filter to go to the wastewater facility somewhere else.

"The EPA has relaxed their radioactive rule a bit, so as long as you're working toward the compliance and working with them, everything is fine. We monitor every month, pulling finished samples and raw samples, so we know exactly how much radium is being removed."

The Village of Oswego was the first municipality in the US to go forward with WRT's Z-88 Radium Removal Process. A number of officials from Oswego actually went out to Colorado and met with the principals involved there.

"We toured not only their Wheat Ridge, Colorado, facility, but also one of their mining sites in Wyoming where the zeolite is acquired," says Weaver. "Since we've been online it has all worked out wonderfully for Oswego. We've actually overbuilt on our well houses so if we have to we can accommodate any changes that may need to be made down the road."

Peter Hildebrandt writes extensively on engineering and scientific subjects.

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